

SECTION 23 20 00 - PIPE JOINING

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Soldering
- B. Brazing
- C. Threading
- D. Flanges
- E. Welding
- F. Heat Fusion Welding

[Note to PSC: This section addresses joining of piping for hydronic and steam systems only. It does not address joining of refrigeration, natural gas or specialty laboratory piping.]

1.2 RELATED SECTIONS

- A. 23 31 13 – Hydronic Piping
- B. 23 21 16 – Hydronic Specialties
- C. 23 22 13 – Steam and Condensate Piping
- D. 23 22 16 – Steam and Condensate Specialties

1.3 REFERENCES

- A. ASME Standard B31.1 – Power Piping
- B. ASME Standard B31.9 - Building Services Piping
- C. ASME Standard B31.5 Refrigeration Piping and Heat Transfer Components
- D. ASME Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications
- E. All applicable ASME Standards for welding and brazing
- F. ASTM B32 – Standard Specification for Solder Metal
- G. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
- H. ASTM 828 - Standard for Making Capillary Joints by Soldering Copper and Copper Alloy Tubes and Fittings
- I. AWS A5.8 – Specification for Filler Metals for Brazing and Braze Welding
- J. AWS B2.1 – Specification for Welding Procedure and Performance Qualification
- K. All applicable AWS D10 Standards
- L. Copper Development Association - Copper Tube Handbook
- M. Illinois Steel Products Procurement Act
- N. International Mechanical Code

1.4 QUALITY ASSURANCE

- A. Products and execution shall be in compliance with applicable codes and standards including those referenced above in paragraph above entitled *REFERENCES*.
- B. Joints shall be warranted to be free from leaks and imperfections for same time period. Defective joints shall be repaired or replaced at no cost to Owner.

C. Installation shall be in compliance with Manufacturer's recommendations.

1.5 SUBMITTALS

A. Product Data

1. Solder and flux
2. Brazing filler metal and flux
3. Flange Gaskets: Type, material, construction, temperature/ pressure rating
4. Bolts and Nuts: Type, material, ASTM identification
5. Weld consumables

B. Documentation

1. Welder qualifications
2. Welding procedures
3. Field records
4. Field test reports

1.6 PRODUCT DELIVERY, HANDLING AND STORAGE

- A. All materials shall be stored indoors protected from temperature, physical damage and exposure to fluids, dust and debris. Containers of solder, brazing and weld consumables, pastes and fluids shall remain sealed until use. Opened containers shall be kept sealed when not in use.

1.7 WARRANTY

- A. All products and installation thereof shall be warranted to be free from defects in material and workmanship for period of one year from date placed into useful service or 18 months from date of delivery, whichever occurs first. Defective product shall be repaired or replaced at no cost to Owner.
- B. All joints shall be warranted to be free from leaks and imperfections for same time period. Defective joint shall be repaired or replaced at no cost to Owner. Impacted piping system shall be manipulated as required to make repair and fluid media shall be brought back to original condition and fill volume at no cost to Owner.

PART 2 - PRODUCTS

2.1 DISSALLOWED PIPE JOINING METHODS

- A. Roll groove or cut groove joints
 1. For exception see *Section 23 31 13 – Hydronic Piping*
- B. Press-connect joints
 1. For exception see *Section 23 31 13 – Hydronic Piping*
- C. Mechanically formed extruded outlets
- D. Piercing valves and fittings
- E. Saddle connections
- F. Welded branch connections
- G. Reducing bushings and flanges
- H. Dielectric unions or fittings
 1. For exception see *Section 23 31 13 – Hydronic Piping*
- I. Other non-standard pipe joints

[Note to PSC: Specifications have not been provided for disallowed joining methods identified above. For projects incorporating limited exceptions as approved by F&S Engineering, AE shall provide required specifications (e.g. groove joints, press-connect joints).]

2.2 PIPE AND FITTINGS

A. Pipe, Fittings, Unions, Flanges

1. See *Section 23 21 13 – Hydronic Piping* for specifications
2. See *Section 23 22 13 – Steam and Condensate Piping* for specifications

2.3 SOLDER JOINTS

A. Approved Fill Material

1. ASTM B32 alloy E
 - a. 95% tin, 5% copper
2. ASTM B32 alloy HB
 - a. Tin-antimony-copper-zinc-silver
3. Not allowed: 95-5 (95% tin / 5% antimony)

[Note to PSC: 95/5 flows thinly and doesn't bridge well. It was a "temporary fix" during the transition from lead to lead-free solder. Consider requiring silver bearing solder for applications where higher strength is desired.]

2.4 BRAZED JOINTS

A. Fill Material

1. Cuprous metal to cuprous metal: 15% minimum silver content
2. Cuprous metal to steel: 45% minimum silver content
3. High temperature, high pressure or lab/process piping applications: 15% minimum silver content
4. Joints difficult to access (e.g. closed chases, underground): 15% minimum silver content

2.5 THREADED JOINTS

A. Thread Sealant

1. Paste type, non-hardening, rated for temperature

2.6 FLANGED JOINTS

1. Gaskets, All Steam Pressures
 - a. Spiral wound type
 - b. Stainless steel with flexible graphite filler material
 - c. Basis of design: Flexitallic Flexicarb (gray stripe)

[Note to PSC: The University has found non-asbestos compressed fiber type gaskets to be inadequate for steam service of any type or pressure. Spiral wound gaskets are required for all steam applications.]

2. Bolts
 - a. Hexagonal: ASME B18.2.1
 - b. Temperatures less than 400F
 - 1) Carbon steel, ASTM A307 Grade B
 - c. Temperatures 400F – 790F

2) Alloy steel, ASTM A193 Grade B7

3. Nuts

a. Hexagonal: ASME B18.2.2

b. Temperatures less than 400F

1) Carbon steel, ASTM A194 Grade B

c. Temperatures 400F – 790F

2) Carbon Steel, ASTM A194 Grade 2H

2.7 WELDED JOINTS

A. Materials and Methods: In compliance with Weld Procedure Specifications (WPS)

B. Welding Requirements: In compliance with section below entitled *WELDING*.

PART 3 – EXECUTION

3.1 SOLDERING

A. Soldering shall be in conformance with *Copper Development Association - Copper Tube Handbook* including:

1. Selection of solder and flux
2. Measuring and cutting
3. Reaming
4. Application of flux
5. Assembly and support
6. Heating
7. Application of solder
8. Cooling and cleaning
9. Testing

B. Destructive Testing

Note to Contractor: Given destructive testing requirements specified below, adequate quality control is required to avoid potentially substantial and costly rework on UIUC projects. Joints will be destructively tested for quality, not just leak-tightness.

1. Destructive testing shall be performed on up to 5% of soldered joints at Contractor's expense. Joints shall be selected by AE or Owner.
2. If any joint is found to be in non-compliance with referenced standards, joint shall be repaired or replaced to satisfaction of AE and up to an additional 10% of joints shall be tested.
3. If additional non-compliant joint or joints are found, all joints identified by AE shall be replaced.

[Note to PSC: The University has experienced frequent leaks in newly installed hydronic systems, particularly those containing glycol. It is important that periodic testing be started early in the project such that any problems are identified and corrected as soon as possible.]

3.2 BRAZING

A. Brazing shall be in conformance with *Copper Development Association - Copper Tube Handbook* including:

1. Selection of filler material and flux

2. Measuring, cutting, reaming
 3. Application of flux
 4. Assembly and support
 5. Applying heat and brazing
 6. Cooling and removing residue
 7. Testing
- B. During brazing, piping shall be purged with oil-free nitrogen.
- C. Joints in following system types shall be brazed:
1. Laboratory and process gas systems
 2. Systems with pressures in excess of 350 PSIG
 3. Systems with temperatures in excess 450 degrees C
 4. Underground copper piping systems
 5. Other systems as indicated in project documents

[Note to PSC: It may be appropriate to braze joints in hydronic piping systems for critical applications.]

- D. Destructive Testing
1. Destructive testing shall be performed as identified above for solder joints.

3.3 THREADED JOINTS

- A. Tapered NPT threads shall be properly cut on piping at joints.
- B. Joint sealant shall be applied.
- C. Torque shall be applied as required to properly seat threads.

3.4 FLANGED JOINTS

- A. Flanges shall be properly aligned with minimal application of force.
- B. Gasket shall be properly positioned.
- C. Bolts shall be inserted and anti-seize compound applied.
- D. Bolts shall be torqued to specified value.

3.5 WELDING

- A. Qualifications
 1. All welders and welding procedure specifications (WPS) shall be qualified as set forth in *ASME Boiler and Pressure Vessel Code, Section IX*
 - a. Welder
 - 1) Prior to performing project welds documentation shall be submitted confirming that each welder has passed required procedure test. Welders shall be qualified as required by *ASME B31.1* or *ASME B31.9* as applicable.
 - 2) Welder qualifications shall be current. If qualification test is more than six months old record of continuity shall be provided indicating welder has performed applicable and approved welding at least every six months since date of qualification test. Record of continuity shall be to satisfaction of AE.
 - b. Weld Procedure Specifications (WPS)
 - 1) Welding procedure specifications shall be provided for project specific welding methods and materials.

B. Weld Record

1. For welding within scope of *ASME B31.1* procedure for locating, monitoring, recording and maintaining quality of welds shall be submitted to AE for approval.
2. Welder identification shall be provided for each weld. Identification shall consist of pipe stamp and welding record. Requirement for welder identification may be relaxed with written approval of AE.

C. Weld Inspection and Examination

1. All welds in piping and piping components shall be carefully visually examined in accordance with *ASME Standard B31.1* or *ASME B31.9* as applicable.
2. Periodically, as welding progresses, report shall be provided indicating status of project welding quality.
3. AE and Owner shall be provided opportunity to observe all aspects of welding prior to, during and after fabrication to assure that proper welding is provided to Owner's satisfaction. Off-site shop welding shall be included. Additionally, Owner maintains right to obtain independent weld examination.
4. AE and Owner shall retain right to stop in-progress welding work until resolution of any concerns are resolved to Owner's satisfaction. Such shall be at no cost to Owner.
5. Welds in piping and piping components shall be radiographically examined only as indicated in project documents. Radiographic examination shall be in accordance with *ASME B31.1*. Number or percentage of welds to be examined shall be as indicated in project documents. Specific welds to be examined shall be selected by AE. Testing agency shall be approved by AE and Owner.

[Note to PSC: Edit spec language above to clearly indicate if radiographic inspection is required and how many welds will be inspected in this manner. Delete phrase "only as indicated in project documents". It may be most helpful to specify number of welds to be inspected rather than percentage.]

D. Welding Procedure

1. All welding shall comply with applicable requirements of referenced *ASME* and *AWA* Standards.
2. All fittings shall be factory standard fittings. Fabricated fittings not allowed.
3. Backing rings shall not be used with welded joints.
4. Interior of pipe and fittings shall be thoroughly cleaned prior to and after welding/assembly.
5. Welds shall be built up with stringer-bead pass followed by hot pass, followed by cover or filler pass.
6. Valleys at center or edges of welds not allowed. Unsound or unfused metal, cracks, oxidation, blow hoes or non-metallic inclusions not allowed. Any such imperfections shall be corrected in compliance with referenced standards and to satisfaction of AE and Owner.
7. When hot-tapping, slag, drillings or "cookies" shall be prevented from entering piping system to greatest degree possible. Any material that enters piping shall be removed by use of magnet after drilling or cutting is complete.
8. Each weld shall be painted shortly after completion to prevent corrosion.

3.6 FUSION WELDING – POLYPROPYLENE

- A. PP-R and PP-RCT polypropylene pipe and fittings shall be fusion welded per Manufacturer's instructions.
 1. Joints in piping 4" and smaller shall be heat fusion socket welded.

2. Joints in piping 6" and larger shall be heat fusion butt welded.

END OF SECTION **23** 20 00

This section of the *U of I Facilities Standards* establishes minimum requirements only.
It should not be used as a complete specification.